DOCUMENT RESUME

ED 025 329 PS 001 490

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Michigan Univ., Ann Arbor. Center for Human Growth and Development.
Spons Agency- National Inst. of Child Health and Human Development, Bethesda, Md.
Report No- UM-CHGD-8
Pub Date 30 Nov 65
Note- 12p.
EDRS Price MF-$0.25 HC-$0.70
Descriptors- *Age Differences, *Association (Psychological), Associative Learning, Children, College Students, *Language Research, Paired Associate Learning, Recall (Psychological), Statistical Surveys, Verbal Learning
Identifiers- *Free Association Norms

Free-association norms for 200 words were obtained in 1964 from the responses of 500 subjects in each of grades four through eight, 10, and 12 and from 1,000 college students. An analysis of this normative data revealed that (1) the frequency of occurrence of the most popular associative responses to stimulus words increases with the age of the subject, (2) the number of different responses to a word decreases with the age of the subject, (3) the response words themselves undergo about a 50 percent change from the fourth grade to college, (4) contrast or opposite responses increase with age, and (5) paradigmatic responses also increase with the age of the subject. Thus, word-association characteristics vary importantly between children and adults. The influence of the associative strength of words on different verbal learning tasks has been investigated. Such an influence has been demonstrated for paired-associate learning, clustering in free recall, associative generalization, and mediated generalization. Normative word association data have also been collected for children in grades one through four. Analysis of these data shows the same trends as observed in the norms discussed for the larger population. (WD)

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Word Associations as Related to Children's Verbal Habits[1]

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In 1964 Jenkins and I published a set of free association norms for 200 words based upon the written responses of 250 boys and 250 girls in each of the grades 4-8, 10 and 12, and 500 males and 500 females in college (Palermo and Jenkins, 1964). We needed the norms for two purposes: (1) to determine whether the associative habits of children are different from those of adults, and (2) to attempt to evaluate the influences which such differences, if found, might have on the verbal learning and verbal behavior of children.

In order to evaluate the differences between child and adult free association responses we examined some of the frequency, grammatical and semantic characteristics of the responses given by the various grade groups. These analyses of the normative data have revealed a number of clear developmental trends. First, the average frequency of the most popular responses increases from Grade 4 through College and the average number of different responses given to any stimulus decreases over the same age span. Not only are the frequency characteristics different but, of the actual words used as responses, only about 50% of the most popular responses given by fourth grade children are the same as the most popular responses given by college students (Palermo, 1963). Examination of semantic relationships between the stimulus and response words reveals that the frequency of responses which are superordinates relative to their stimuli increases from Grade 4 to Grade 6 and declines steadily from sixth grade to college (Palermo and Jenkins, 1963). Contrast or opposite responses, on the other hand, steadily increase in frequency from Grade 4 through College (Palermo, 1964). Finally, analysis of the grammatical relationships between the stimuli and responses indicates that the frequency of paradigmatic responses increases from Grade 4 through College although the initial level and rates of increase vary considerably from one grammatical class to another. In addition, for all of these developmental trends, the typical finding that girls are more advanced than boys in various language measures is consistently apparent (Palermo, 1963). While there are many kinds of analyses which could be made of the normative data, these results appear sufficient to clearly establish the fact

PS001490

that the associative habits of children are different, at least in degree, from those of adults. Furthermore, a comparison of the normative data of the fourth and fifth grade children in our sample with those of a comparable group of fourth and fifth grade children collected by Woodrow and Lowell in 1916 (Palermo and Jenkins, 1965) indicates that there are marked changes which have occurred over the 45 year period between the two norm collections. All of the changes suggest that children today are more like adults in their responses. I have argued that this is one indication that children are more linguistically sophisticated now than was the case 45 years ago, although the one attempt we have made to relate language development to word association responses was not particularly encouraging (Tobiessen, 1964).

Since marked differences in the associative characteristics of the responses of children and adults have been demonstrated, the primary focus of the research has turned to the influence which such differences might have on the performance of children in a variety of verbal learning and verbal behavior tasks. Thus far, we have examined the influence of verbal associative habits upon paired-associate learning, mediation, recall, tachistoscopic recognition, generalization and discrimination. Reports on some of these data have been published, so I will only review the procedures and results briefly.

The research began with an examination of the influence of normatively reflected associative habits upon the paired-associate learning of children. Using both mixed and unmixed list designs, it has been demonstrated (Wicklund, Palermo, and Jenkins, 1964) that differences in associative strength do influence the rate of paired-associate learning of children. The differences in rate of learning are clear regardless of whether comparison is made of the rate of learning responses at various positions in the associative hierarchy of the same stimulus or, whether comparison is made of the rate of learning pairs composed of stimuli and their primary responses where associative strength of the primary varies. The stronger the associative strength between the stimulus and response the faster the rate of learning. The most interesting aspect of these findings is the fact that they cannot be replicated with college students. Unless low frequency words are used (Postman, 1962; Martin, 1963), college students learn a list of words which are associated to any

degree so rapidly that no differences in learning rate may be demonstrated except between some level of associative strength and none. The fact that associative strength affects the learning rate of children but not that of adults may be interpreted as indicating that the associative connections between words, reflected in the norms, are positively related to age, presumably reflecting differences in language experience.

In order to extend these findings and to attempt to determine when the associative strength variable loses its effectiveness, Wicklund (1964) has replicated the earlier studies with children in grades 4, 6, 8 and 10. The results of this study, rather surprisingly, showed that the associative strength variable continues to affect rate of learning in a statistically significant manner even at the 10th grade level. At all grade levels, Wicklund found that pairs composed of stimuli and their primary responses of 20-50% normative strength were learned faster than pairs with 10% normative strength which in turn were learned faster than pairs with a 1% normative strength. All groups learned in less than half the trials necessary for a group to learn a list of unassociated word pairs. Thus, the differential influence of associative strength on paired-associative learning does not disappear until after the 10th grade but before college. The possible alternative interpretation that there is a difference in the populations sampled, does not obviate the relationships observed, but might be worthy of investigation to clarify the effects of language facility on the associative strength variable.

A second type of task in which the influence of the associative strength variable has been examined is that of clustering in recall. On the basis of three experiments, conducted with fourth and sixth grade children, there is ample evidence to conclude that associative clustering does occur in the free recall of children of this age. These studies have shown, with fourth grade children, that given a randomly arranged list of 30 words within which are 15 pairs of stimuli and their primary responses taken from the appropriate norms, recall of the list will occur in associatively related clusters of stimulus and response pairs. Furthermore, the probability of clustering is positively related to the associative strength of the stimulus and the primary response, at least in the range from 10 to 64% (Wicklund, Palermo, and Jenkins, 1965). As might be expected, the total amount of recall

is less for children than for adults, but more significantly, the relative percentage of clustering as a function of opportunities to cluster appears to be less for children than for adults. In an unpublished study with sixth grade children (MacLean, 1963), it was found that the amount of clustering could be increased by repetition of the list three or five times. The amount of repetition necessary to influence clustering was less for a list composed of pairs with an average associative strength of 56% than for a list of pairs with 14% strength. The data of these three studies further support the contention that the associative strength reflected in the normative data of children does not have as strong an influence upon the behavior of children as is the case with adults where amount of clustering has been shown to account for a larger proportion of the variance in this situation (Jenkins, Mink and Russell, 1958).

A third type of task investigated involves the Mink (1963) associative generalization procedure. Here the subjects, fifth grade children, were presented a list of 12 stimulus words from the word association list and told to try to remember the words and to press a telegraph key as each word was presented. After two presentations of the list, a second list of words was presented with instructions to press the telegraph key each time a word from the first list appeared. The second list was composed of six of the first list words, the six primary associates to those words, the other six words of the first list and six control words which had no associative strength to any of the 12 words in the first list. The associated words had a mean normative strength of approximately 64%. The percent of presses was approximately 84% to the first list words regardless of whether their associates were in the list or not, 23% to the associated words and 7% to the control words. A second study, with some minor modifications, replicated the results of this study. In contrast to the studies of paired-associate learning and clustering in recall, the results of the studies of associative generalization provide little evidence for relative differences in performance of children and adults. The amount of generalization to the associated words, and the errors to the control words are approximately the same for the children as in the studies conducted by Mink (1963) and Martin (1961) with college students.

Still a fourth type of task in which the influence of associative connections has been observed in children was reported in a recent thesis by Gallagher (1965) in our laboratory. Using stimulus words from the word association list as fixation words, he determined the recognition thresholds of words associatively related to the fixation word. His subjects were drawn from the fourth, eighth and twelfth grades. The results indicated that recognition thresholds decrease from fourth to twelfth grades,but, most importantly, at all grade levels the words associatively related to the fixation word were reported accurately at shorter exposure intervals than words with no associative relationship to the fixation word. While this relationship appears to be primarily due to the establishment of an associative guessing set created during the task (Verinis and Cofer, 1964), the results indicate that such sets can be as easily established in the fourth grade child as has been demonstrated for the twelfth grade child and for college students (O'Neil, 1953).

Verbal mediation in the paired-associate situation is a fifth area toward which attentio has been directed. Thus far, we have used four of the eight three stage mediation paradigms (Jenkins, 1963): two chaining paradigms (Nikkel and Palermo, 1965; Flamer, 1964), a reverse chaining paradigm and a response equivalence paradigm (Palermo, in press). In each case, the first link in the associative chain was assumed from the normative data for sixth grade children, and the children were required to learn the second and third stages using trigrams as the third member of the associative chain. In all cases, using both mixed and unmixed lists, comparisons have been made of performance on lists arranged to produce mediated facilitation and interference relative to performance on control pairs for which no known mediational links were present. Although the magnitude of the differences between facilitation and control and interference and control conditions has varied with the paradigm and the use of mixed and unmixed lists, the results have consistently provided support for the mediation hypothesis. The results of these studies, as was the case with associative generalization, appear to be as definitive as any which have been obtained with adults. As a matter of fact, it would appear that the influence of the mediational effects last well into the learning task whereas the studies with adults find mediation effects are most prominent in the early trials.

PS001490

One other study should be mentioned here in contention with both the early studies of paired-associate learning as a function of associative strength and the studies of mediation. Taking a lead from a theoretical model proposed by Jarrett and Schiebe (1963), children were used to test the hypothesis that not only the rate of learning direct associates but also the rate of learning pairs of words which are associated only through a mediating word would be a function of associative strength (Palermo and Jenkins, 1964). Strong support was found for Jarrett and Schiebe's model, which proposed that multiplying the associative probabilities of two pairs of words A-B and B-C would allow prediction of the rate of learning a pair, A-C, which has no direct associative connection. The data suggest that a list of pairs of words, A-B, which are directly associated with a probability according to the norms of, say, .20 will be learned at the same rate as a list of pairs of words, A-C, which are not directly related but do have the connection that A elicits B with a probability of .50 and B elicits C with a probability of .40. Thus, with children, it is possible to predict the relative rate of learning directly associated pairs, as indicated previously, and, in addition, we can account for the rate of learning pairs in a mediation situation based on multiplying the associative probabilities of the individual links in the mediational chain. Again, the difficulty of demonstrating such relationships with college sophomores might be emphasized because of the apparently high degree of association which any word which appears in the adult norms seems to have in terms of influencing paired-associate learning.

Finally, a partial failure in the experimental program should be presented. Since it had been demonstrated that children generalize from one word to its associate in the Mink associative generalization situation, it was assumed that given a situation in which discrimination between words is required, children would have more difficulty discriminating between associatively than non-associatively related words. Furthermore, the amount of difficulty in the discrimination task should be positively related to the strength of the associative connection between the two words. In an initial effort to test this hypothesis, two lists of 10 word pairs were constructed; one of high strength primary associates and the other of low strength primary associates. Fifth grade children were randomly assigned

to a list and required to learn the 10 simultaneous discrimination problems in each list as they were presented on a memory drum. While the children did not make a large number of errors, there was no indication that they were having more difficulty with the strongly associated pairs than the others.

Since that time, four other experiments have been completed on discrimination learning with college students using simultaneous and two forms of successive discrimination learning procedures. The results demonstrate convincingly that our original hypothesis was correct, at least for the older population. In the three studies which have been analyzed, it has been found consistently that pairs of words which are highly associated prove to be significantly more difficult to discriminate than pairs which are not associated according to the normative data. Pairs of words with an intermediate level of associative strength have fallen in between, although performance has not always been statistically different from both the high and the unassociated word pairs. Analysis of the difficulties with the study conducted with the children leads to the conclusion that either the task was not difficult enough to demonstrate differences or that associative strength is not a strong enough variable to affect the performance of grade school children in this type of task. One of my students is in the process of setting up a study to clarify which of these hypotheses may be correct.

By way of summarizing the data presented thus far, it appears that associative data collected from children not only show characteristics which are different from those of adults but, in addition, the influence of these associative characteristics on the performance of children in a variety of verbal learning tasks reveals a number of differences. The influence of associative strength on paired-associate learning is clear, and performance in this task is quite sensitive to variations in associative strength, both direct and mediated. The amount of clustering in free recall is apparent but not so marked as is the case for adults. The perceptual recognition, associative generalization and mediated generalization tasks have not shown clear differences relative to the findings obtained with the college sophomore, although in the latter task, the effects of associative strength appear to influence the performance of children throughout the learning task rather than

being limited to the early trials. At this point, little can be said about the relative performance of children and adults on a verbal discrimination task.

The experimental problems discussed up to this point have dealt largely with upper elementary school children. While clear differences have been established between the performance of these children and the college sophomore, the results have continually suggested that the use of younger children might allow further insights into some of the issues involved. Thus, normative word association data have been collected from children in grades 1-4 for 100 of the 200 words used in the original normative collection. The tests were administered orally and responses given orally by 50 boys and 50 girls in each of the grades. The stimulus words included all the parts of speech as well as superordinate and contrast-eliciting stimuli.

Analysis of these normative data indicates that all of the trends observed in the larger norms extend downward on the age dimension as might be anticipated. As with the other norms, the popular responses increase in frequency, as do superordinates, contrasts and paradigmatic responses. The most striking aspects of the data are the much larger grade to grade increases observed, particularly the changes from Grade 1 to Grade 2. One is tempted to be impressed by what the child apparently learns about his language in the first grade. It is perhaps worthy of note here that the oral administration has the effect of increasing the probability of a popular response by approximately 35%, increasing the probability of a contrast response approximately 100% and decreasing the probability of a superordinate response approximately 20%. Paradigmatic responses also are more probable under the oral administration procedure. These latter results are based upon a comparison of the fourth grade children who were given the oral administration and the original norm group which took a written form of the test.

Experimentally these normative data have been used for only one study at this date. Last year a study was conducted which was patterned after the earlier studies by Wicklund in which the influence of associative strength on paired-associate learning was examined. A tape recorded presentation of the lists was used with oral responses by first and fourth grade children. At each grade level, three different lists of eight pairs were constructed

in which the associative strength of the stimuli and responses was approximately 20-45%, 5% or 0%. All subjects were run for a minimum of 15 trials. Significant differences were found in the rate of learning the lists in line with the previous findings using visual presentation with older children. The size of the performance differences between lists were much larger for the first grade children than for the fourth grade children. There were no inversions in the predicted order of the means on any trial for the first grade children while the fourth graders had reached nearly perfect performance on both of the associated lists by the fourth trial. The control, or 0%, lists were markedly more difficult in both grade groups. The data of the first grade are particularly encouraging for two reasons: first, the children adapted to the procedure of aural paired-associate learning beautifully and, second, the effects of the associative strength variable were obvious and lasted well into the learning task. It now appears quite feasible to attempt some studies of mediation with the younger children as well as some of the other kinds of tasks which have been used with the older children.

Finally, there is a serendipitous finding which has come out of this work which is both interesting and puzzling. In several studies in which control lists of unassociated words have been used, it has been found that when an unassociated word has been paired with a stimulus which has a strong primary response it is easier to learn that pair than if the word is paired with a stimulus which has a weak primary response according to the normative data. As of this date, this finding has been replicated six times. Thus far, the use of mixed or unmixed lists, part of speech of the stimulus, and age of subjects have been eliminated as variables which can account for these results. In the most recent study, trigrams were used as responses and the result was once again replicated. There is one hitch to the finding: exactly the opposite finding was obtained with one fourth grade group which learned a control list in Wicklund's doctoral dissertation. The question remains for our laboratory: Why is it easier (most of the time) to learn a list of unassociated words when the stimuli in the list have high strength primary free associates than when the stimuli have low strength free associates?

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Footnote

1. The research reported in this paper was supported by research grants HD-00961 from the National Institutes of Health, USPHS and GB-2568 from the National Science Foundation. In addition, the writing of this paper was supported by a Public Health Service research career program award HD-28,120 from the National Institute of Child Health and Human Development, USPHS.